Technology: Optoelectronics

BRIEFS

Microlase range finders

Insight Technology in Londonderry, NH received a sole-source $10m firm-fixed-price contract for small tactical optical rifle-mounted microlaser range finders. Insight also makes a wide range of rifle and pistol mounted illuminators and laser aiming devices, and is a leading supplier of tactical lights and lasers to US Special Operations Forces. Work on the contract will be performed in Billerica, MA and is expected to be complete by January 2007.

Vishay buys CyOptics Israel

Vishay Intertech Inc's Vishay Israel Ltd unit is to buy CyOptics Israel Ltd, the Israeli subsidiary of CyOptics Inc, Breinigsville, Pa. CyOptics Inc itself recently bought the optoelectronics operation in Breinigsville, and Matamoros, Mexico from TriQuint Semiconductors Inc.

Terms were not disclosed, but Vishay, Malvern, said the purchase price was immaterial. CyOptics Israel designs optical components for field use, that employ advanced IR technology. It has an Israel plant that produces GaAs and InP chips used for optoelectronics.

DVD civil war

Japanese electronics giants are to go ahead with incompatible formats for next-gen DVDs, after talks to reach a common standard failed, leaving consumers with the VHS, Betamax video cassettes dilemma of the 1970s.

Next-generation DVDs are expected to hit the mass market later this year.

Toshiba Corp was in talks with Blu-ray Sony to find a common format, but in the absence of an agreement it was going ahead with production of its own format.

UV laser manipulates aluminium energy

NIST researchers trap aluminium and beryllium ions in the device above, in experiments designed to produce an atomic clock that could be significantly more precise than today's most accurate atomic timepiece. As reported in Science, *the tandem technique involves use of a single beryllium ion to accurately sense the higher-frequency vibrations of a single aluminium ion.*

Physicists at the Commerce Department's National Institute of Standards and Technology (NIST) have used the natural oscillations of two different types of charged atoms, or ions, confined together in a single trap, to produce the 'ticks' that may power a future atomic clock.

The NIST group used ultraviolet lasers to transfer energy from the aluminium's vibrations to a shared 'rocking' motion of the pair of ions, and then detected the magnitude of the vibrations through the beryllium ion.

The new technique solves a long-standing problem of how to monitor the properties of an aluminum ion, which cannot be manipulated easily using standard laser techniques.

The tandem approach might be used to make an atomic clock based on optical frequencies, which has the potential to be more accurate than today's microwave-based atomic clocks. It may also allow simplified designs for quantum computers.

"Our experiments show that we can transfer information back and forth efficiently between different kinds of atoms. Now we are applying this technique to develop accurate optical clocks based on single ions," said Till Rosenband of NIST's laboratories in Boulder, Co.

Today's international time and frequency standards measure naturally occurring oscillations of caesium atoms that fall within the frequency range of microwaves, about 9bn cycles per second.

By contrast, optical frequencies are about 100,000 times higher, or about one quadrillion cycles per second, thus dividing time into smaller units.

Aluminum may offer advantages over other atoms, such as mercury, being considered for optical atomic clocks.

Building a clock based on aluminium ions has been impractical until now because this atom fails to meet three of four requirements. It does oscillate between two different energy states at a stable, optical frequency that can be used as a clock reference.

However, aluminium cannot be cooled with existing lasers, and its quantum state is difficult to prepare and detect directly. The *Science* paper describes how beryllium, a staple of NIST research on time and frequency standards, as well as quantum computing can fulfill these three requirements, while the aluminium acts as a clock.

In the NIST experiments, the two ions were confined close together in an electromagnetic trap.

The beryllium ion was laser cooled and slowed to almost absolute zero temperature, which helped to cool the adjacent aluminum ion.

Then the scientists used a different laser to place the aluminium ion in a special quantum state called a 'superposition,' in which, due to the unusual rules of quantum physics, the ion is in both of its clock-related energy levels at once.

More laser pulses were used to convert this clock state into a rocking motion which, because of the physical proximity of the two ions and the interaction of their electrical charges, was shared by the beryllium ion.

As the two ions rocked together in a coordinated fashion, scientists applied two additional laser beams to convert this motion into a change in energy level of the beryllium ion, which was then detected.

When the information is transferred between the two ions, they are briefly "entangled."

A logic operation borrowed from quantum computing was used to transfer the aluminum's quantum state to the beryllium. Logic operations are similar to "if/then" statements in which the outcome depends on the initial state.

By repeating the experiment many times, with different laser frequencies creating a variety of superposition states in the aluminum, scientists could determine its 'resonant' or characteristic frequency very accurately.

This is the frequency of an internal vibration of the aluminum atom, which can be used as the 'ticks' of an atomic clock.

The tandem technique could be used to investigate the potential of various atoms, such as boron and helium, for use in optical atomic clocks, or in quantum computing experiments to distribute information between different types of ions or atoms.

Because different atoms respond to different frequencies of light, this could improve control of ions or atoms within a potential future quantum computer.

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